

Claims

- [c1] A modified microbe made by a process that comprises circulating a fluid in a loop and within said fluid

(A) presenting microbes with an opportunity to attack target cells;

(B) removing from said loop microbes having a lesser affinity for said target cells and leaving within said loop microbes having a greater affinity for said target cells;

(C) presenting microbes with an opportunity to attack non-target cells;

(D) removing from said loop microbes having a greater affinity for said non-target cells and leaving within said loop microbes having a lesser affinity for said non-target cells; and

(E) mutating microbes within said loop.

[c2] A modified microbe according to Claim 1 wherein microbes are removed in step (B) by providing a semipermeable membrane through which said microbes can pass but said target cells cannot pass, where said membrane separates said fluid into a first part containing said microbes and a second part containing said microbes and said target cells, and removing said first part from said loop.

[c3] A modified microbe according to Claim 1 wherein microbes are removed in step (D) by providing a semipermeable membrane through which said microbes can pass but said non-target cells cannot pass, where said membrane separates said fluid into a first part containing said microbes and said non-target cells and a second part containing said microbes, and removing said first part from said loop.

[c4] A modified microbe according to Claim 1 wherein said target cells are from the same species as said non-target cells.

[c5] A modified microbe according to Claim 1 wherein said target cells and said non-target cells are from different species.

[c6] A modified microbe according to Claim 1 wherein said non-target cells are human.

[c7] A modified microbe according to Claim 1 wherein said microbes are bacteria.

- [c8] A modified microbe according to Claim 1 wherein said microbes are viruses.

[c9] A modified microbe according to Claim 8 wherein said target cells are cancer cells and said non-target cells are normal cells.

[c10] A modified microbe according to Claim 9 wherein said viruses are selected from the group consisting of adenoviruses, rhinoviruses, and mixtures thereof.

[c11] A modified microbe according to Claim 1 wherein ultraviolet light is used to mutate said microbes.

[c12] A modified microbe made in an apparatus that comprises

 - (A) first, second, and third containers, each having two sections, I and II, separated by a semipermeable material through which a microbe can pass but cells from target and non-target populations cannot pass, and an entrance and an exit to each section, where the entrance to section I of said first and second containers is a circulation entrance, the exit from section II of said first and second containers is a circulation exit, and the entrance to and exit from section I of said third container is a circulation entrance and a circulation exit, respectively;
 - (B) conduits forming a loop by connecting the circulation exit of each container to the circulation entrance of another container;
 - (C) a pump for moving fluid around said loop; and
 - (D) means for mutating microbes in said fluid;

by a process that comprises

 - (A) passing cells from a target population in an aqueous fluid into the entrance to section II of said first container;
 - (B) passing an aqueous fluid without microbes or cells in it into the entrance of section II of said second container;
 - (C) passing cells from a non-target population in an aqueous fluid into the entrance of section II of said third container;
 - (D) adding microbes to said loop;
 - (E) circulating said aqueous fluid around said loop;
 - (F) mutating some of the microbes in said loop; and

(G) collecting microbes from said loop after they have an enhanced ability to attack cells from said target population or to not attack cells from said non-target population.

- [c13] A modified microbe according to Claim 12 wherein sections I are cylinders and sections II are tubes within said cylinders, and said tubes are made of said semipermeable material.
- [c14] A modified microbe according to Claim 12 wherein one of said containers is higher than the other two containers and one of the two lower containers is higher than the other of the two lower containers, so that said fluid flows by gravity from the highest container to the lowest container.
- [c15] A modified virus that attacks cancer cells but does not attack normal cells, made by a process that comprises circulating a fluid in a loop and within said fluid
 - (A) forming a first mixture of said cancer cells and particles of at least one type of virus;
 - (B) removing from said loop virus particles having a lesser affinity for said cancer cells and leaving within said loop virus particles having a greater affinity for said cancer cells;
 - (C) forming a second mixture of said normal cells and said virus particles;
 - (D) removing from said loop virus particles having a greater affinity for said normal cells and leaving within said loop virus particles having a lesser affinity for said normal cells; and
 - (E) mutating virus particles within said loop.
- [c16] A modified virus according to Claim 15 wherein said cancer cells are prostate cancer cells.
- [c17] A modified virus according to Claim 15 wherein said cancer cells are breast cancer cells.
- [c18] A modified virus according to Claim 15 wherein said normal cells include normal cells from the same type of tissue as said cancer cells.

- [c19] A modified virus according to Claim 15 wherein said cancer cells all have the same DNA profile for genes that code for molecules on their surface.

[c20] A modified microbe according to Claim 15 wherein said viruses are selected from the group consisting of adenoviruses, rhinoviruses, and mixtures thereof.